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RESEARCH MEMORANDUM

for the

Signal Corps, U. S. Army

CALIBRATION OF THE FRIEZ AEROVANE, WIND MEASURING SET AN/GMQ-11

By John W. McKee

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Langley Field, Va.

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
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SUMMARY

Calibrations of the Friez Aerovane, Wind Measuring Set AN/GMQ-11, manufactured by the Friez Instrument Division of the Bendix Aviation Corporation, were made in the Langley 300 MPH 7- by 10-foot tunnel at the request of the Signal Corps, U. S. Army. Two propellers and two generators were tested through a speed range of 15 to 190 knots. The results indicated that at airspeeds greater than 80 knots the instrument indicated airspeeds higher than the tunnel airspeed.

INTRODUCTION

At the request of the Signal Corps, U. S. Army, calibrations of the Friez Aerovane, Wind Measuring Set AN/GMQ-11, have been made in the Langley 300 MPH 7- by 10-foot tunnel. The Friez Aerovane, shown installed in the tunnel in figure 1, consists of a wind vane with a 3-blade, wide-chord propeller of about $15\frac{1}{2}$ inches diameter driving a direct-current generator. The output of the generator was read on an associated instrument with a scale from 0 to 120 knots. A switch was incorporated in this instrument to provide a reduction ratio of 2:1 in the readings so that full scale could also correspond to 240 knots. The output of the generator was also read simultaneously on a Hewlett-Packard vacuum-tube voltmeter model 410A, serial number 915, furnished with the Aerovane. Calibrations were made through a speed range of 15 to 190 knots of two propellers and two generators. Representatives of the Signal Corps and of the Friez Instrument Division of the Bendix Aviation Corporation were present and aided in obtaining the test data.

RESULTS AND DISCUSSION

The data obtained for the four combinations of the two generators and two propellers are presented in tables I to IV. In figure 2 it can be seen that somewhere in the vicinity of 80 knots airspeed the indicator readings begin to depart from the line of perfect calibration and at the top airspeed of 190 knots the indicator is reading high by an appreciable amount. The tunnel airspeed is believed to be correct to within ±2 knots in the region of 190 knots. In addition, the variation of generator voltage with indicator reading is shown in figure 3 to be linear. It is suggested as a possible explanation of the nonlinear calibration that the effects of centrifugal force or aeroelasticity would be such as to tend to decrease the blade pitch angle and increase the rotational speed and that these effects would become more pronounced as the speed increased. No data are available to evaluate the magnitude of these effects.

Langley Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., December 11, 1953.

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Approved: Thomas A. Harris

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TABLE I

CALIBRATION OF GENERATOR NO. 750 WITH PROPELLER NO. 750

Tunnel airspeed, knots	Friez indicator, knots	Volts
15.8	14.1	1.78
21.6	21.0	2.55
31.9	31.0	3.90
42.5	43.0	5.25
53.2	53.5	6.60
63.9	64.0	7.95
74.6	76.0	9.30
85.4	88.0	10.7
96.1	98.0	12.0
106.7	110.0	13.5
117.7	60.5	15.0
128.6	66.5	16.5
135.3	70.5	17.4
146.2	76.5	18.5
156.4	82.0	20.0
167.7	89.0	21.8
177.8	96.0	23.5
189.1	105.0	25.6

TABLE II

CALIBRATION OF GENERATOR NO. 751 WITH PROPELLER NO. 751

Tunnel airspeed, knots	Friez indicator, knots	Volts
15.2	15.0	1.85
20.3	21.5	2.50
30.8	32.0	3.75
43.0	41.5	5.25
53.8	53.0	6.65
64.0	63.0	7.90
74.8	75.0	9.20
86.0	86.0	10.5
106.6	109.0	13.4
117.9	120.0	14.8
128.4	65.0	16.2
134.9	69.0	17.0
145.2	75.5	18.4
156.2	81.0	19.8
166.9	87.5	21.5
177.2	94.0	22.9
188.2	102.0	24.8
159.2	84.0	20.5
140.9	73.5	18.0
117.7	60.0	14.8
101.1	103.0	12.6
95.8	98.0	11.9
64.1	63.0	7.70
43.0	41.0	5.05

TABLE III

CALIBRATION OF GENERATOR NO. 751 WITH PROPELLER NO. 750

Tunnel airspeed, knots	Friez indicator, knots	Volts
21.3	21.5	2.55
52.9	53.0	6.45
84.6	85.5	10.5
105.6	107.0	13.4
127.2	64.5	16.0
144.0	74.5	18.4
165.4	87.0	21.5
186.5	100.5	24.8

TABLE IV

CALIBRATION OF GENERATOR NO. 750 WITH PROPELLER NO. 751

Tunnel airspeed, knots	Friez indicator, knots	Volts
21.1	21.0	2.60
52.7	53.5	6.58
84.7	87.0	10.7
116.7	60.5	14.9
127.1	66.0	16.2
144.2	76.0	18.7
165.0	88.0	21.5
186.2	101.0	24.8

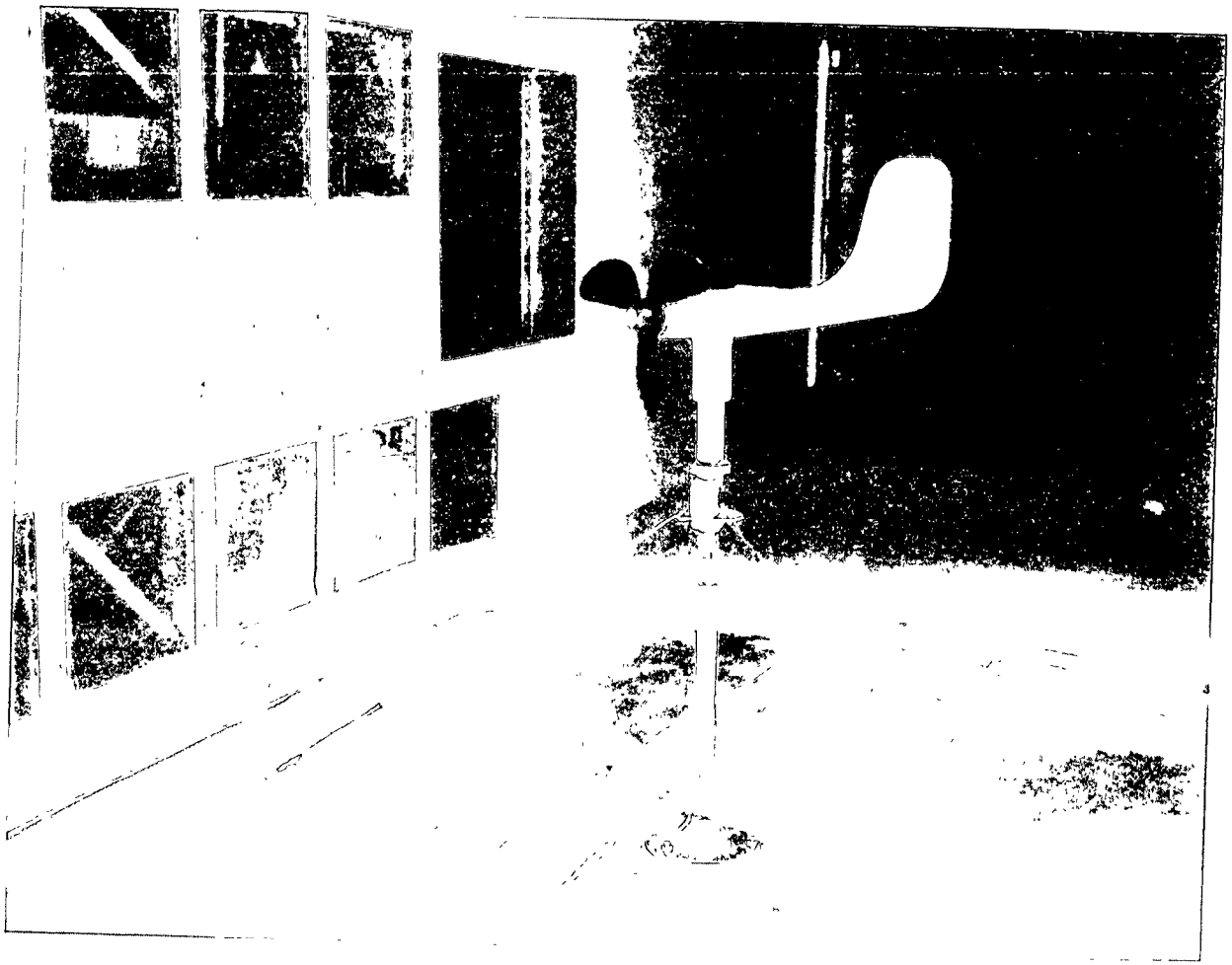

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Figure 1.- Friez Aerovane, Wind-Measuring Set AN/GMQ-11, mounted in the Langley 300 MPH 7- by 10-foot tunnel.

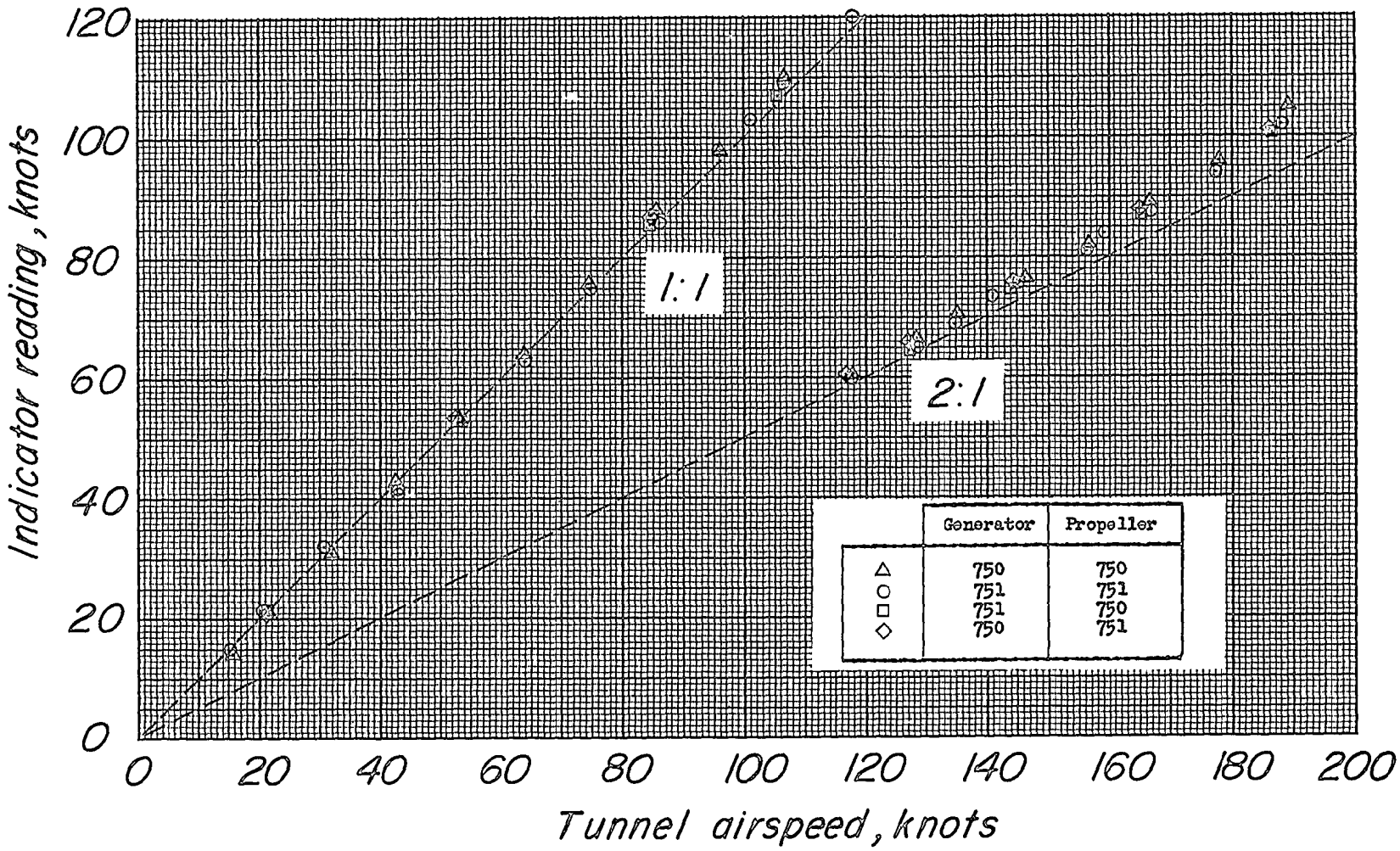

Figure 2.- Variation of indicator reading with tunnel airspeed.

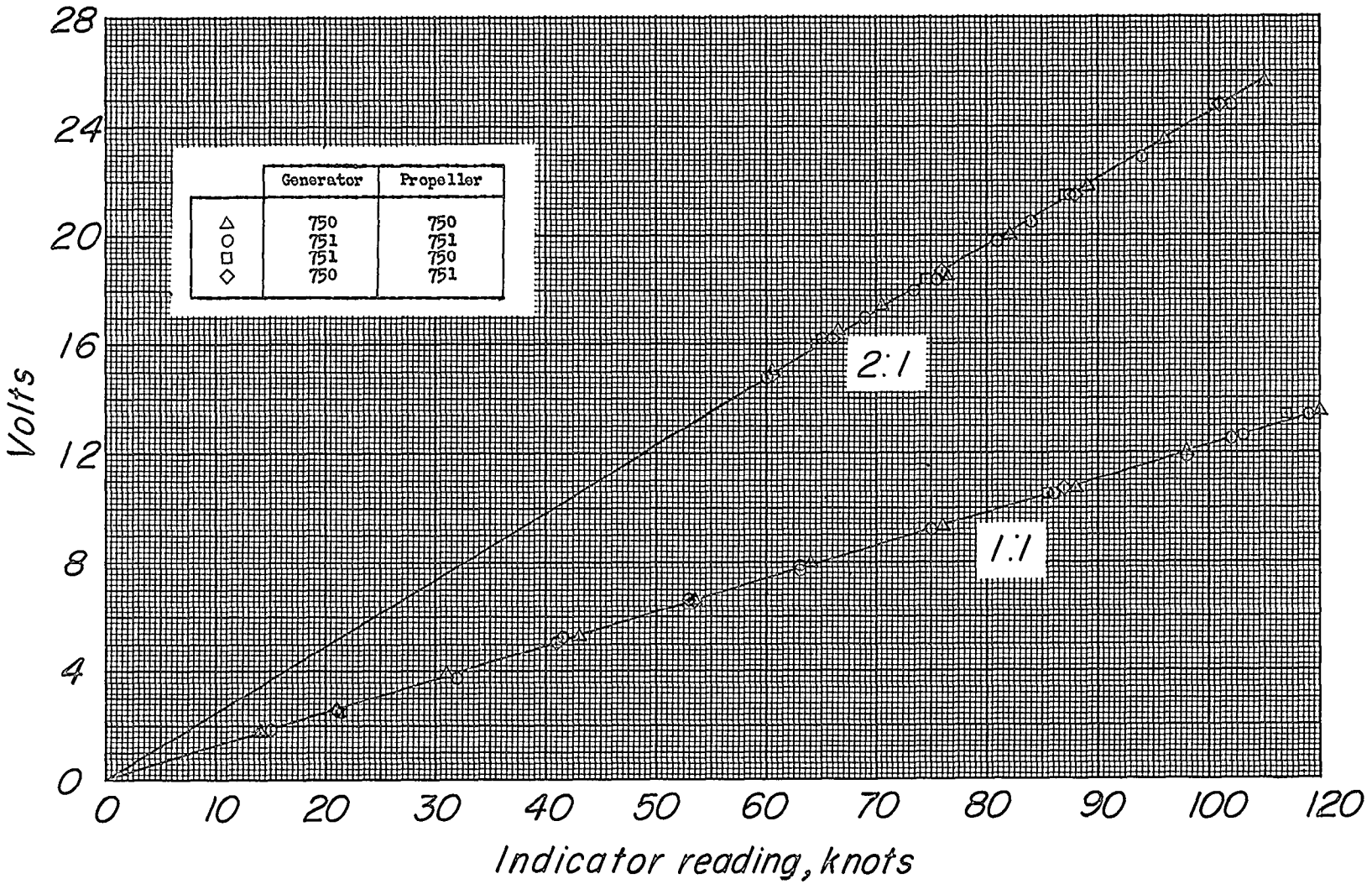

Figure 3.- Variation of measured voltage with indicator reading.